

A Redescription of *Ledermuelleria frigida* HABEEB

(Acarina : Prostigmata : Stigmaeidae)

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ABSTRACT: *Ledermuelleria frigida* HABEEB, a little-known, moss-feeding mite is redescribed in all its stages from specimens collected in southern Quebec. Morphological characters which occur in all stages of the mite are noted and afford the best features for its definition. Scanning electron micrographs are presented to illustrate some parts of *L. frigida*.

INTRODUCTION

Mites of the genus *Ledermuelleria* OUDEMANS, 1923, comprise a group of globose, reddish animals whose bodies are covered by a heavy, usually ornamented armour. This dorsal covering is separated (in the females) into propodosomal and hysterosomal shields, there being also a small, ventrally-displaced suranal plate. In the male, the dorsal shield is sometimes divided, and the animal is smaller than the female. The genus *Ledermuelleria* is closely related, within the family Stigmaeidae, to the genera *Mullederia* WOOD and *Ledermuelleriopsis* WILLMANN. The former differs from *Ledermuelleria* by having only one large dorsal shield covering the entire idiosoma, whereas the females of the latter genus have their hysterosoma divided, like the males of some *Ledermuelleria*.

The taxonomy of this genus is relatively well understood. SUMMERS (1957) and SUMMERS and PRICE (1961) redescribed many of the old species, described several new ones and established a broad base for the recognition of additional species. Later, CHAUDHRI (1965) named 11 new species from North, Central and South America, and WOOD (1966) added another 9 from New Zealand. Al-

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together, close to 40 species are currently recognized within the genus *Ledermuelleria*.

Studies on moss-inhabiting mites in Canada (GERSON, in press) have shown that some *Ledermuelleria* species feed and reproduce on mosses. Several of these mites were reared in the laboratory and the life history of one of them, *L. frigida* HABEEB, was studied in detail. Specimens of all stages of this species thus became available and form the basis for the present paper. It is intended here not only to present a redescription of the little-known *L. frigida*, in modern taxonomic terms, but also to discuss the variability of some characters of taxonomic importance in this genus.

The terminology used is based on GRANDJEAN(1944), SUMMERS and PRICE(1961) and CHAUDHRI (1965). Terms referring to the genitalia are from SUMMERS and EHARA (1965). Another character not much used previously, but believed to be of some value, is the relationship between the total length of the chelicerae (t) and the length of the cheliceral stylets (s) as shown in Fig. 5. In the text this is indicated by the ratio t/s. Intersetal distances are abbreviated in the text to *a-a*, meaning, in this example, the distance between these setae.

In studying the females and males, measurements were taken from 10 specimens of each sex and their means calculated. These means, as well as the parenthesized ranges, are recorded in the descriptions. In studying the developmental stages, only 5 of each of these were measured. All measurements are in microns. The scanning electron microscope micrographs (Plate 1, nos. 1—8) were taken by a Cambridge "Stereoscan" instrument⁽²⁾. The mites were freeze-dried in liquid air for 10 hours, coated with gold palladium and then scanned.

Ledermuelleria frigida HABEEB

Ledermuelleria frigida HABEEB, 1958, Leaflets of Acadian Biology, No. 18. p. 4.

Type locality and habitat : Grand Falls, New Brunswick, Canada, in water of a small beaver pond. The syntypes, two females, in HABEEB's collection.

Diagnosis : This species differs from other known *Ledermuelleria* in the lateral displacement of setae *b*, in having strong, barbed dorsal setae on tubercles, in the pattern of the dorsal ornamentation, and in having small, thin

⁽²⁾ Made available through the courtesy of the Pulp and Paper Research Institute of Canada, Pointe Claire, Quebec

stylets which are less than one-third as long as the entire chelicerae.

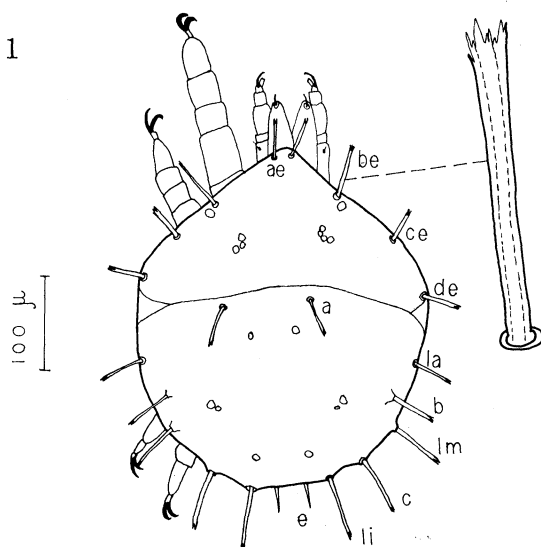


Fig. 1. *Ledermuelleria frigida*, female. Dorsal aspect.

FEMALE: Idiosoma pear-shaped, 390 (363–428) long, 341 (294–390) wide (at humeral sulcus), tapering anteriorly to a blunt point, where setae *ae* are located (Fig. 1). Dorsal dimples or pits with upper (outer) and lower (inner) margins irregularly rounded; inner walls of pits vacuolated, so that a vacuolated halo appears around the opening of each dimple; these pits relatively deep, with a cavern-like aspect (Plate 1, 3–4). Dimples small in central areas of propodosoma and hysterosoma (Plate 1, 1–2), their diameters enlarging by about 3 times towards idiosomal margins. Dimples occupying center of underlying polygonal reticulations, the latter more evident on mid-idiosoma due to the smallness of the pits. Fossetts appearing as rounded, vacuolated, shallow depressions on dorsum of idiosoma, 4–5 arranged in a crescent on either side of propodosoma, between setae *ce*, and another 3–4 pairs located in tandem series on hysterosoma. One pair of eyes present, located behind setae *be*, their corneae bulging and not much larger than adjoining pits (Plate 1, 5). Dorsum with 13 pairs of setae (including the ventrally-displaced *he*, *le* and *e*), these thick, parallel-sided almost to their distal ends, where most are divided into 3–5 barbs; some setae (*ae*; *be*; *ce*; *a*; *b*) tending to be more barbed and thus somewhat clavate. Some specimens have the apical ends of other setae covered

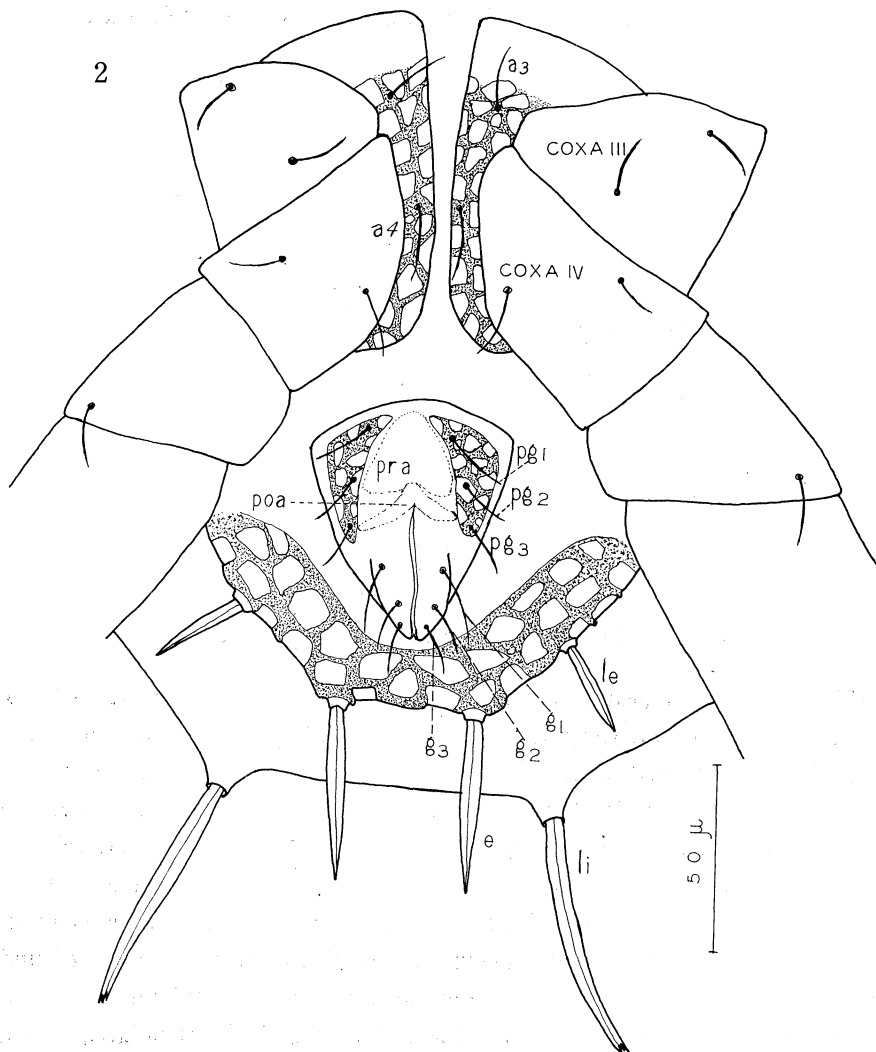


Fig. 2. *Ledermuelleria frigida*, female. Ventral aspect of opisthosoma.

by a hyaline sheath, which imparts to the setae a more pointed appearance. Measurements of dorsal setae presented in Table I. Most dorsal setae placed on tubercles, *b*, *lm*, *c* and *li* on the largest ones. Setae *a* located in usual dorso-central position, but *b* and *c* laterally displaced, almost in line with setae *la* and *lm* (Fig. 1), distance *b*—*b* consequently being more than twice (2.4) distance *a*—*a*. Setae *le* and *e* on dimpled suranal plate (Fig. 2), and *he* on reticulated

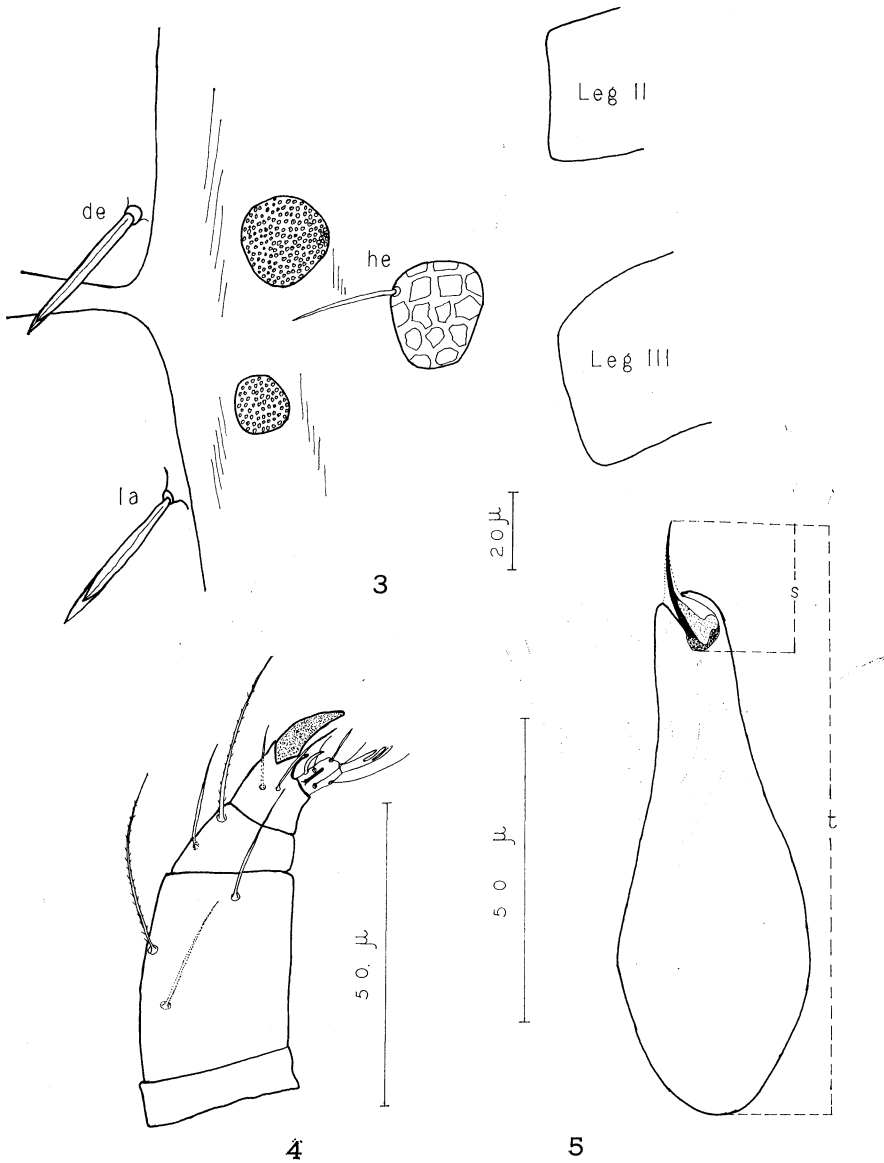


Fig. 3. *Ledermuelleria frigida*, female. Lateral aspect.

Fig. 4. *Ledermuelleria frigida*, female. Palpus.

Fig. 5. *Ledermuelleria frigida*, female. Chelicera. Letters t and s denote total cheliceral length and stylet length, respectively, to demonstrate mode of measuring.

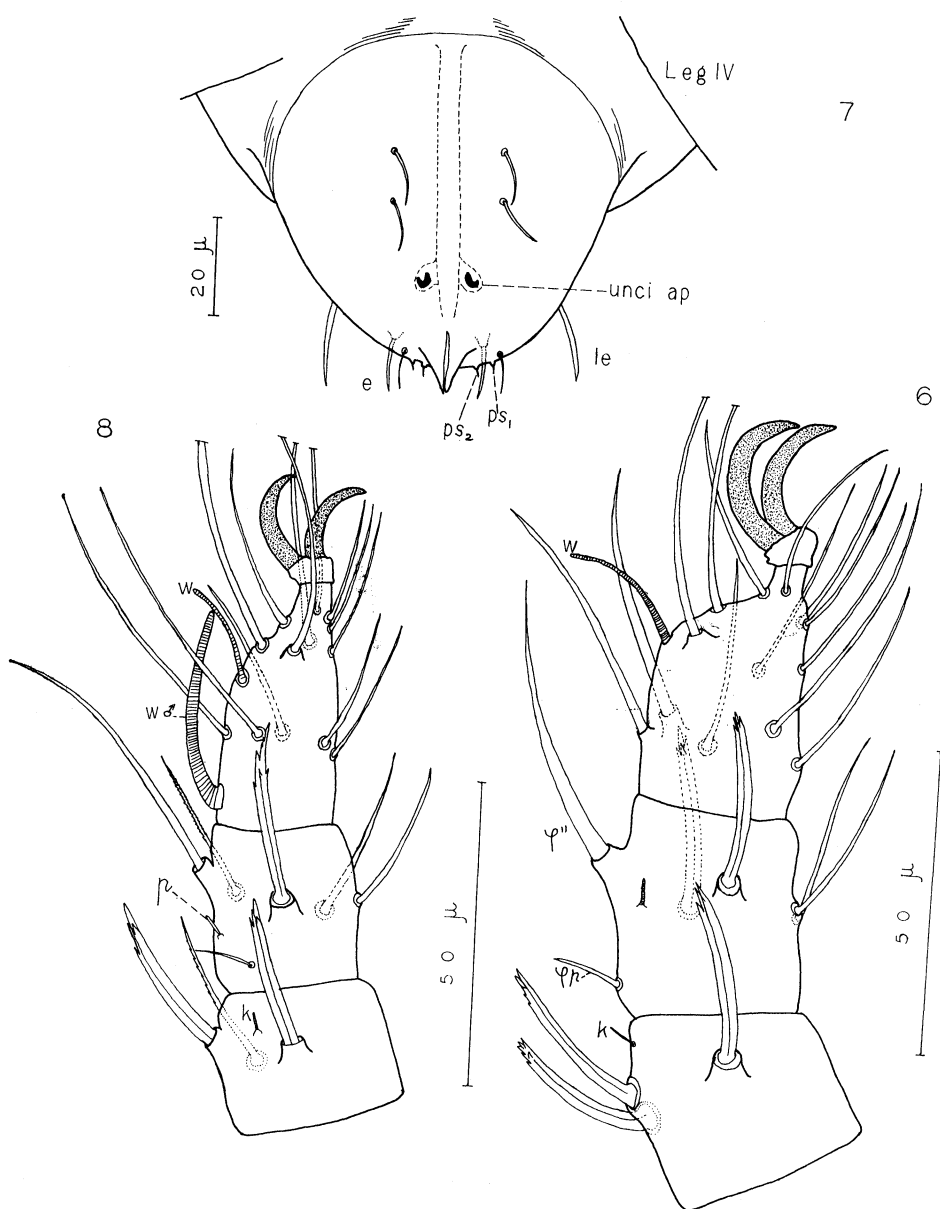


Fig. 6. *Ledermuelleria frigida*, female. Distal segments of leg I, empodium omitted.

Fig. 7. *Ledermuelleria frigida*, male. Ventral aspect of opisthosoma.

Fig. 8. *Ledermuelleria frigida*, male. Distal segments of leg I, empodium omitted.

humeral platelets (Fig. 3). Two pairs of callosities-oval areas with vacuolated surfaces (Fig. 3) — present, located, on either side, anteriorly and posteriorly to humeral platelets, respectively. Endocoxal plates of propodosoma and metapodosoma strongly reticulated and separated in mid-line by several longitudinal striations. Venter of idiosoma with 3 pairs of hair-like setae (1*a*, 3*a*, 4*a*) located on endocoxal plates between coxae I, III, and IV, respectively. Anogenital plates dimpled, each with 3 pairs of paragenital setae, 12–18 long. Inner structure of genitalia discernible between plates, composed of a large preatrium (pra in Fig. 2) and a narrow, small postatrium (poa in Fig. 2). Genital setae 14–21 long, the anterior pair being somewhat longer than the other setae.

Gnathosoma about 130 long (from base of fused coxae to tip of tibial claws). Coxae punctate (in some specimens also reticulate) and with a small subapical spine. Trochanter narrow, ring-like. Femur the largest palpal segment, with 3 setae. Genu with 2 setae. Tibia also with 2 setae, inserted on either side of segment, a claw as long as tibia and a small accessory claw (Fig. 4; Plate I, 6). Tarsus cylindrical, with a nail-like basal sensillum, 1 curved seta inserted near sensillum, an apical trifid sensillum or trident, whose shaft is as long as its prongs (Plate I, 6) and 4 additional setae, one of which is longer than the trident. Total length of punctate chelicera (t in Fig. 5) 98, stylets 23 long, ratio $t/s=4.2$. Stylets thin, about 1 thick. Internal pharyngeal pump more apparent on venter of gnathosoma, where its underlying sclerotized image is flanked by the subcapitular setae *m* and *n*.

Legs : Coxae II and III close together, distance between them less than diameter of either. All coxae punctate and in some specimens also reticulate. Leg I (from base of trochanter to tip of claw) 222 (203–252) long ; legs II and III 187 (175–203) ; leg IV 216. Inclusive counts of setae and sensilla on podomeres of legs I–IV ; coxae 2–2–2–2 ; trochantera 1–1–2–1 ; femora 6–5–3–2 ; genua 4–4–1–1 ; tibiae 7–6–6–6 ; tarsi 14–10–8–8. Sensillum *w* present on all tarsi, curved and about 25 long on tarsus I (Fig. 6), nail-like on tarsus II and reduced on tarsi III–IV. Dorsal and lateral setae on podomeres strong, barbed and set on tubercles, ventral setae smaller and smoother. All legs with 2 claws and empodium (omitted in Figs. 1 and 6) between them. Empodial shaft with 3 pairs of capitate hairs (Plate I ; 7, 8), the apical of which is the largest. Basal part of claws enveloped in hyaline cover.

Live mites red, with dark guts.

MALE : Similar to female in general appearance, but with some differences.

Plate I

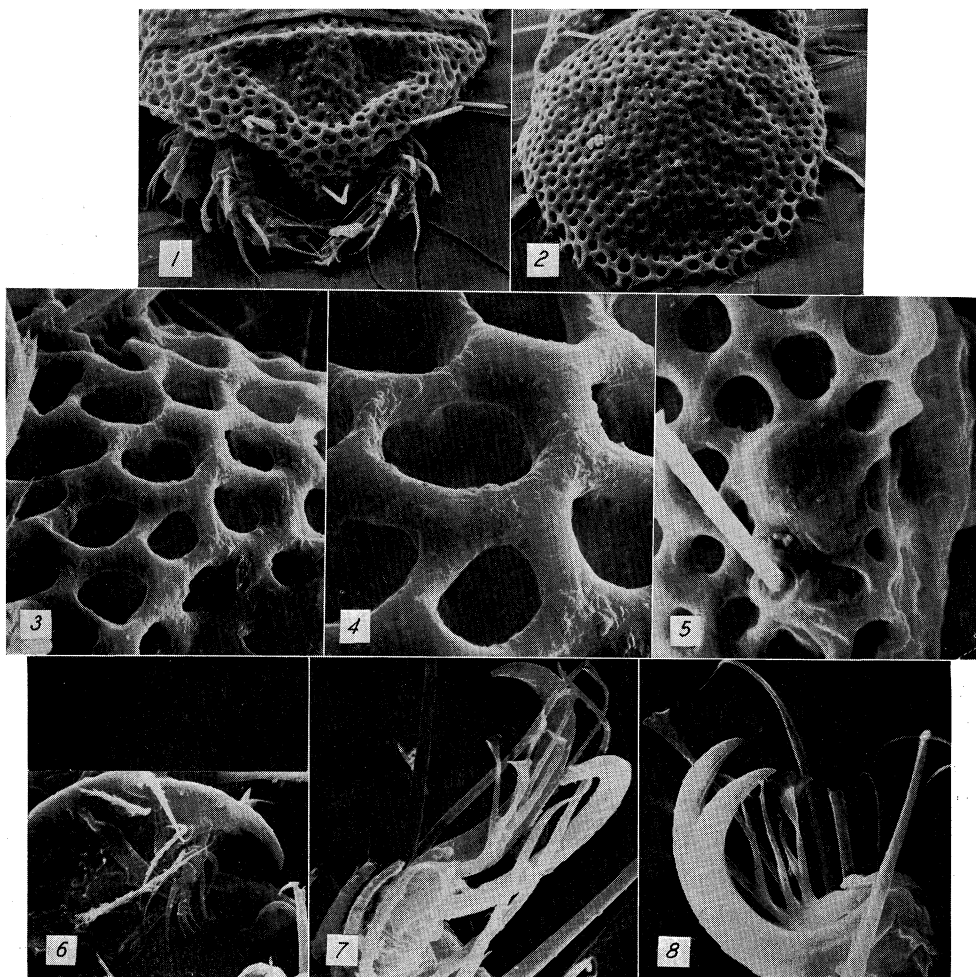


Plate I. Scanning electron micrograph of *Ledermuelleria frigida*, female.

- No. 1. Dorsal aspect of propodosoma, $\times 320$.
- No. 2. Dorsal aspect of hysterosoma, $\times 320$.
- No. 3. Dorsal propodosomal dimpling behind setae *ae* (seen in left-hand corner), $\times 1650$.
- No. 4. Dorsal propodosomal dimpling, detail of preceding micrograph, $\times 3300$.
- No. 5. Dorsal seta *be* and eye, $\times 1700$.
- No. 6. Palpclaw and palptarsus, $\times 1350$.
- No. 7. Claw and empodium of leg I, ventral view, $\times 3100$.
- No. 8. Claw and empodium of leg I, lateral view, $\times 2800$.

Dorsum of propodosoma mostly with small dimples surrounded by vacuoles, enlarged pits confined to margins. Hysterosoma with small dimples throughout. Dorsal setae approximately one-third smaller than female homologues, but *le* 85% of female *le*; *c* 46%, *e* 21%. Hysterosoma undivided, differing in this respect from the males of some other *Ledemuelleria* (*L. rhodomela*, *L. schusteri* and others). Distance *b*—*b* more than twice distance *a*—*a*. Suranal region more posterior than in female and completely underlying hysterosomal plate. Posterior callosity obscure, only a few vacuoles evident at its location in some specimens. Venter of opisthosoma with 3 pairs of acicular paragenital setae, the anterior 2 pairs placed close together, third pair⁽³⁾ on posterior margin of body (Fig. 7). Also on this margin 2 pairs of small tubercles, on each of which a minute seta is placed (setae *ps* 1, *ps* 2 of GRANDJEAN, 1944). Aedeagus a slender shaft, 57 (45–63) long, fortified near posterior end by 2 strongly sclerotized, upward-bending uniform appendages (unci ap in Fig. 7).

Leg I 212 long (85% of female leg I), legs II–III 150 (80%), leg IV 166 (77%). Setae on legs as in female, but all tarsi with additional basal sensillum *w* ♂ (Fig. 8). Idiosoma 265 (245–308) long, with gnathosoma 350 (325–388). Gnathosoma and chelicerae 80–85% of female homologues, stylets 87%, ratio *t/s*=3.9.

Live mites with shiny dorsal integument, otherwise red like females.

DEUTONYMPH: Idiosoma 320 long, with gnathosoma 406, width 285. Dorsal dimpling as in female, but less sclerotized. Dorsal setae barbed, unsheathed, set on tubercles, *he* and *le* 23 long, *ce* and *a* 35, *ae* and *e* 38, *de* 41, *be*, *b* and *la* 44, *li* 51, *c* and *lm* 54. Distance *b*—*b* more than twice distance *a*—*a*. Both pleural callosities evident. Ventral setae as in female, inner parts of genitalia indiscernible. Leg chaetotaxy as in female, except that trochanter IV is without seta, there are only 4 setae on femur II and the formula for the genua is 4–3–0–0. Sensilla on podomeres as in female. Chelicera 80 long, stylets 21, ratio *t/s*=3.8.

PROTONYMPH: Idiosoma 201 long, with gnathosoma 282, width 192. Large, unevenly-rounded dorsal dimpling recognizable. Dorsal setae barbed, set on tubercles. Setae *he*, *le* 14 long; *ae*, *ce*, *a* and *e* 23; *de* 30; *be*, *b*, *la*, *li* 34; *lm* 40. Distance *b*—*b* twice *a*—*a*. Only anterior callosity discernible. Total length of chelicerae 62, stylets 18, *t/s*=3.6. Palpcoxal spine inserted at midsegment.

⁽³⁾ GRANDJEAN (1944) argues that this pair of setae is homologous with the third pair of female anal setae (setae *g*₃ in Fig. 2).

Venter of gnathosoma with only the anterior pair (*m*) of the infracapitular setae. Ventral intercoxal setae *4a* not present. Genital plates with the anterior pair of paragenital setae only. Setae on podomeres of all legs : coxae 2—2—2—0 ; femora 4—4—3—1 ; genua 4—3—0—0 ; tibiae 7—6—6—6 ; tarsi 14—10—8—7. Sensilla as in female.

LARVA : Idiosoma 148 long, with gnathosoma 212, width 134. Large dorsal dimpling, though somewhat obscure, may be observed. Dorsal setae barbed, set on tubercles (Fig. 9). Setae *li* ventrally displaced and setae *le*, *e* occur near undeveloped anogenital opening (Fig. 10). Setae *he*, *le* 7 long ; *ce*, *de*, *a*, *li* and *e* 19 ; *ae* 23 ; *la*, *b*, *c* and *lm* 27, and *be* largest on dorsum, 31 long. Distance *b*—*b* 1.8 times distance *a*—*a*. Anterior callosity large, bulging, with seta *de* inserted on this bulge, apparently off propodosomal shield, posterior callosity indiscernible. Coxa of palpus with relatively enlarged apical spine, femur with 2 setae and genu with 1 only, otherwise as in subsequent stages. Total length of chelicerae 51, stylets 15, *t/s*=3.4. Infracapitular setae *m* and *n* and intra-coxal setae *4a* absent. Venter of opisthosoma without paragenital setae, the 3 pairs of genital setae minute. Leg chaetotaxy : coxae 1—0—0 ; trochantera 0—0

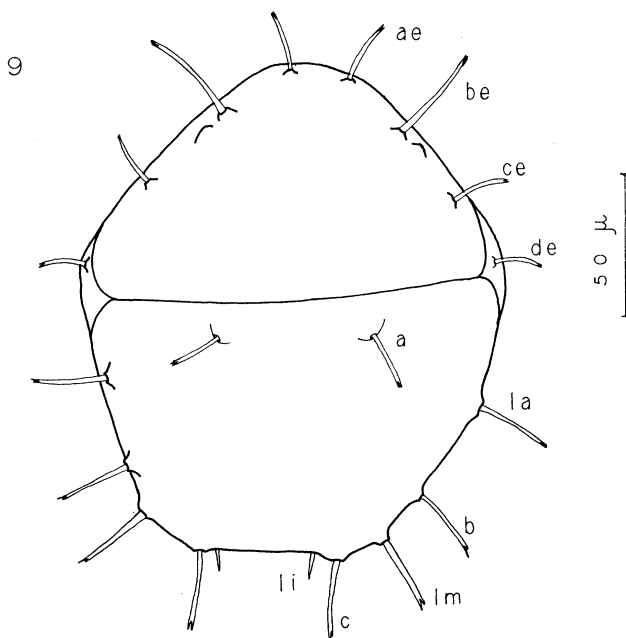


Fig. 9. *Ledermuelleria frigida*, larva. Dorsal aspect of idiosoma.

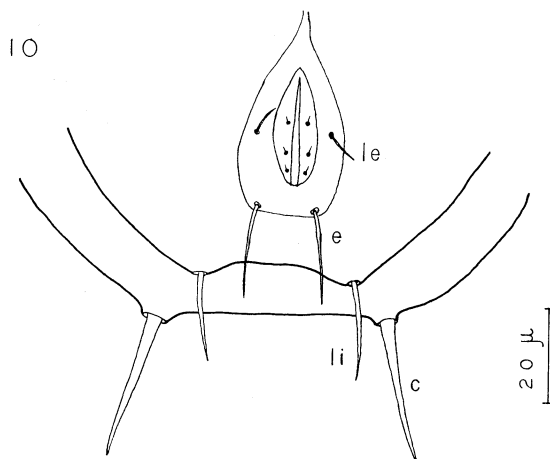


Fig. 10. *Ledermuelleria frigida*, larva. Ventral aspect of opisthosoma.

—0 ; femora 4—4—3 ; genua 3—3—0 ; tibiae 7—6—6 ; tarsi 14—10—8. Sensilla as in female. Tarsi I and II with 1 pair of dorsal duplex setae, i. e., 2 setae whose alveoli are appressed. One of these setae long, flagellate, the other minute.

COLLECTION DATA : Province of Quebec : Baie d'Urfé, in *Heterophyllum haldanianum* mosses on a rotten log ; July 30, 1968 ; Daveluyville, in mats of *Bryhnia novae-angliae*, growing on shaded arboreal roots, September 28, 1968 ; Ile Bizard, in mats of *Leptodictyum riparium* occurring on shaded arboreal roots, August 10, 1968 ; Montmorency Falls, in *Cratoneuron filicinum* on hillside strongly covered by spray from falls, September 25, 1968 ; St. Faustin, in *H. haldanianum* growing on forest soil, August 20, 1968 ; Ste Anne de Beaupré in mats of *Leskea polycarpa* on rotten logs, September 25, 1968 ; Ste Helene, in *Brachythecium salebrosum* growth on shaded rocks, September 24, 1968, and from the moss *Hypnum lindbergii* growing on rotten logs, Ormstown, November 11, 1968. Many additional specimens were obtained from an unidentified moss at Lac Sarpent by Miss M. J. Reid, July 18, 1968. Collection records from Ontario are : Maxville, September 14, in mats of the mosses *Thuidium delicatulum* and *Sharpiella turfacea* on rotten logs.

Slides of *L. frigida* were deposited in the Lyman Entomological Museum, Macdonald College of McGill University, Province of Quebec, Canada ; at the Canadian National Insect Collection, Entomology Research Institute, Ottawa, Canada ; at the United States National Museum, Washington, D. C. ; at the

Table 1 : Measurements (in microns) of the body (idiosoma and gnathosoma) and dorsal setae of 10 *Ledermuelleria frigida* females obtained from different localities.

Origin of specimen (Quebec except Maxville)	Body total	Seta ae	Seta be	Seta ce	Seta de	Seta he	Seta a	Seta b	Seta c	Seta la	Seta lm	Seta li	Seta le	Seta e
Ile Bizard	433	46	53	32	42	21	46	45	60	38	60	60	21	42
Ste Helene	440	46	53	46	42	32	42	42	63	42	56	63	28	49
Ormstown	460	42	53	39	42	28	46	52	60	53	56	63	32	45
Laboratory culture	460	38	53	35	38	25	32	45	60	38	49	56	21	45
Ste Anne de Beaupré	460	46	56	39	46	25	42	49	60	49	60	63	32	49
St Faustin	460	42	49	39	42	32	39	42	56	42	49	56	28	45
Maxville (Ontario)	468	42	56	42	38	32	42	49	60	42	56	36	28	45
Baie d'Urfé	486	49	53	42	38	25	49	49	60	35	53	63	32	49
Daveluyville	490	46	60	42	45	32	45	49	67	53	63	66	25	49
Lac Serpent	524	49	63	45	45	25	49	52	67	45	60	66	28	49
Mean	468	47	55	40	42	28	43	47	61	44	56	62	27	47
S. E. (±)		3.3	3.8	4.1	2.9	3.8	4.8	3.5	3.3	5.9	4.5	3.4	3.9	2.5

Department of Entomology, University of California, Davis, California, at the British Museum (Natural History), and in the author's collection, Rehovot, Israel.

REMARKS : The development of stigmatid mites and the homologies of their various setae have been described by GRANDJEAN (1944). His scheme, with small modifications, is also applicable to *L. frigida* and will not be further discussed. Some attention, however, will be given to certain characters believed to be of taxonomic value.

Dorsal ornamentation : The larvae and protonymphs have large, more or less uniform dimples on their dorsum. Differentiation into smaller (at mid-idiosoma) and larger (on body margins) dimples becomes evident in the deutonymph. The large, unevenly-rounded dimples are thus present, though variously distributed, during all active stages.

Dorsal setae : These are barbed and set on tubercles throughout the active stages of *L. frigida*. Another stable feature is the lateral displacement of setae *b*, causing distance *b-b* to be from 1.8 (in the larva) to 2.4 (in the female) larger than distance *a-a*.

Chelicerae : The occurrence of small, thin stylets is characteristic of all stages of this mite. The stylets are always inserted at the anterior part of the fixed digits and always less than one third of the total length of the chelicera.

The characteristic dorsal ornamentation, the form and displacement of the dorsal setae and the small thin stylets are features stable throughout the development of *L. frigida*. For this reason they are considered to afford the best taxonomic characters for the definition and recognition of this species.

The main features used to recognize, define and separate females of species of *Ledermuelleria* are : nature, length and position of various dorsal setae ; details of dorsal ornamentation ; presence or absence of eyes ; occurrence of pleural callosities ; number of ventral, intercoxal and paragenital setae ; number of setae on femur II and tarsus IV, and the length of the cheliceral stylets (SUMMERS and PRICE, 1961 ; CHAUDHRI, 1965 ; WOOD, 1966). Several of these characters, like the posterior callosities and the full complement of setae, occur only in the later stages of *L. frigida*, but others are discernible from the larval stage on. Possibly these or other features occur in the early stages of other species of *Ledermuelleria* also, and may therefore be employed for the development of a larval or nymphal classification of this genus.

ACKNOWLEDGEMENTS

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REFERENCES

- CHAUDHRI, W.M. 1965. New mites of the genus *Ledermuelleria*. *Acarologia* 7 : 467—486.
- GERSON, U. Mites of the genus *Ledermuelleria* (Prostigmata : Stigmaeidae) associated with mosses in Canada. *Acarologia*, in press.
- GRANDJEAN, F. 1944. Observations sur les acarins de la famille Stigmaeidae. *Archs. Sci. phys. nat.* 26 : 103—131.
- HABEEB, H. 1958. New mites from New Brunswick. *Leaflet. Acadian Biol.* 18 : 1—4.
- SUMMERS, F.M. 1957. American species of *Ledermuelleria* and *Ledermuelleriopsis*, with a note on new synonymy in *Neognathus*. *Proc. Entomol. Soc. Wash.* 59 : 49—60.
- SUMMERS, F.M. & S. EHARA, 1965. Revaluation of the taxonomic characters in four species of the genus *Cheylestigmaeus* WILLMANN (Acarina : Stigmaeidae). *Acarologia* 7 : 49—62.
- SUMMERS, F.M. & D.W. PRICE, 1961. New and redescribed species of *Ledermuelleria* from North America (Acarina : Stigmaeidae). *Hilgardia* 31 : 369—387.
- WOOD, T.G. 1966. Mites of the genus *Ledermuelleria* Oudemans. (Prostigmata, Stigmaeidae) from New Zealand, with records of one species from some southern Pacific islands. *N. Z. Jl. Sci.* 9 : 84—102.